Missouri's Life Sciences Strategy: Preliminary Analysis and Review

Presented to:

Governor's Higher Education Conference

Prepared by:

Technology Partnership Practice

Battelle Memorial Institute

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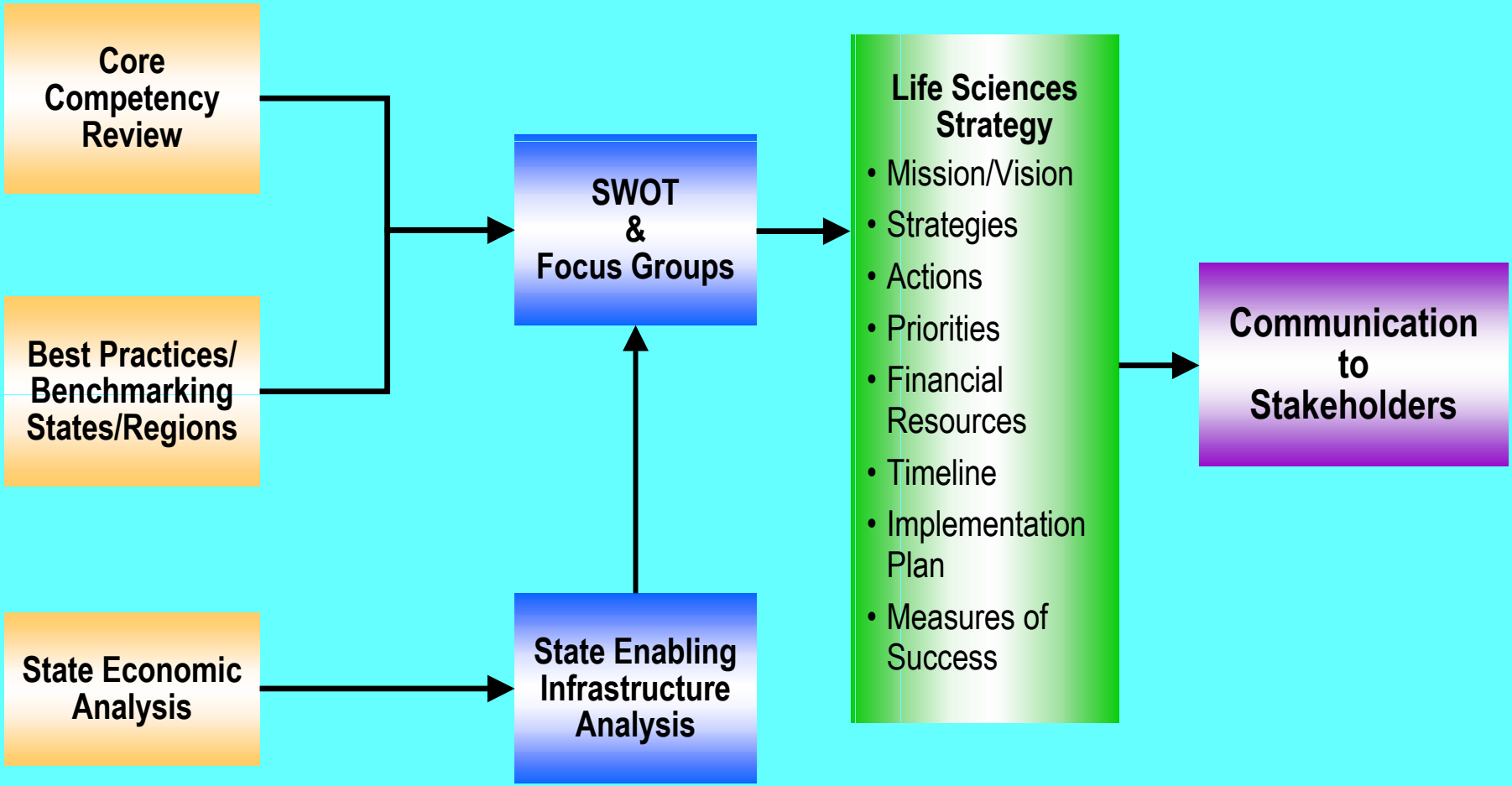
Methodology for Missouri Life Sciences Strategy Development



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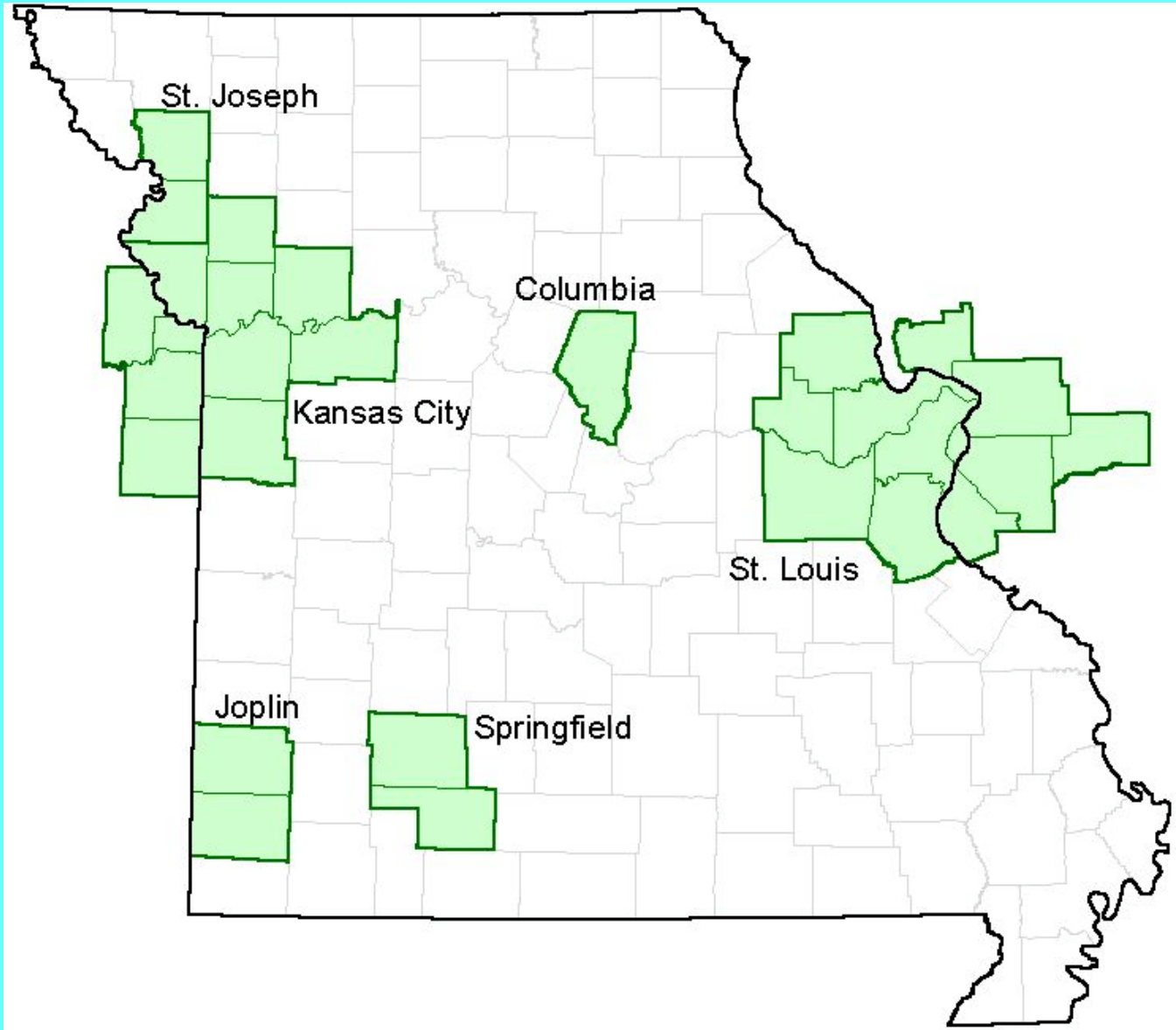
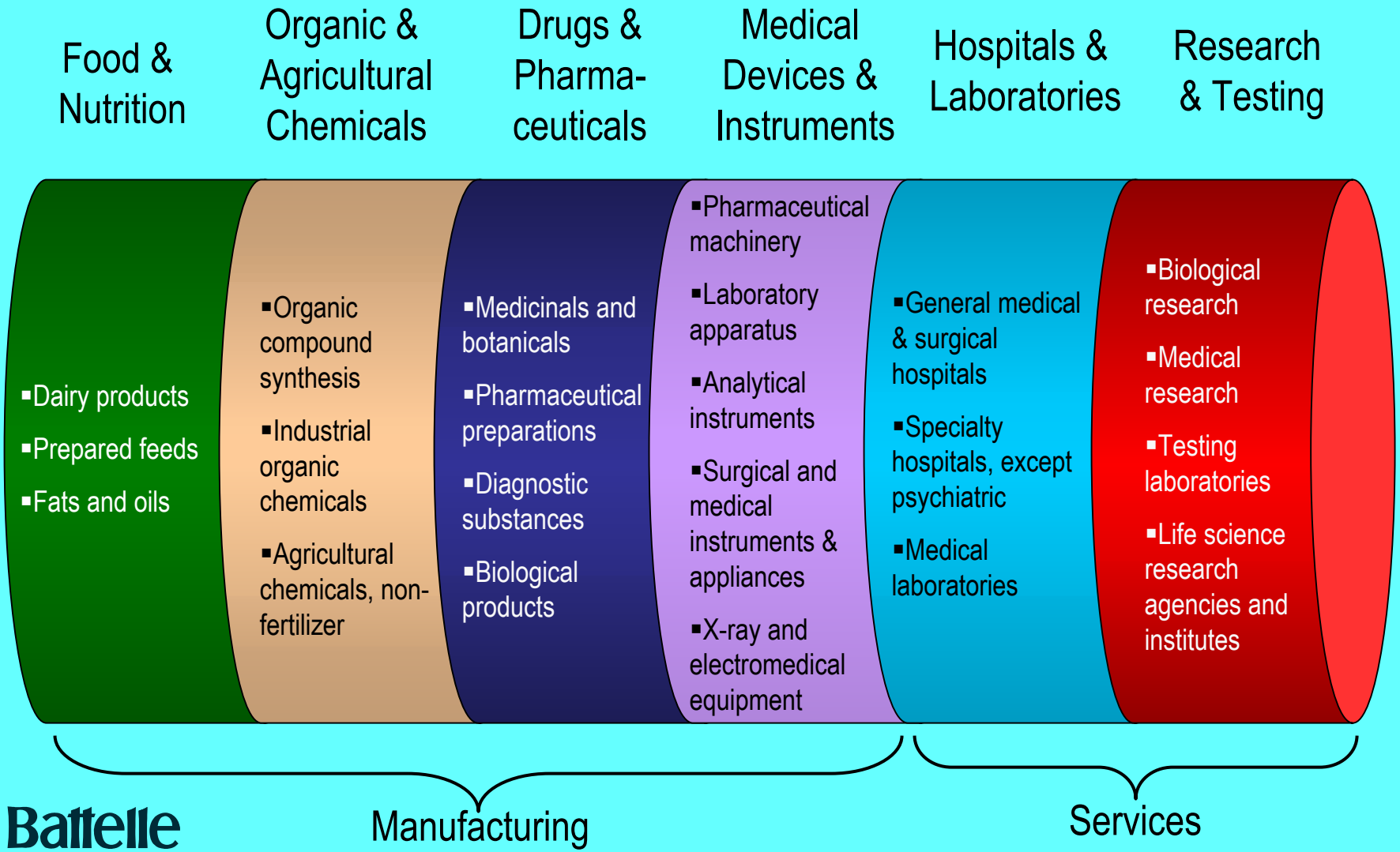
Definition of Missouri Region

- All of Missouri plus those counties in Kansas and Illinois that are part of Missouri's multi-state metropolitan regions—Kansas City and St. Louis.



Definition of Life Sciences—6 subsectors



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Summary Data—Entire Life Science Sector

Metrics	Missouri	United States
Total Population, 2001 (thousands)	6,901	281,422
Life Science Establishments, 2001	1,815	68,781
average employment size	*106*	*99*
Life Science Employment, 2001	193,117	6,810,918
percent of entire private sector	*5.54*	*4.87*
Location Quotient (compared to U.S.)	1.14	N.A.
location quotient change, '95-'01	*+0.10*	---
Life Science Establishment Chg., '95-'01 (pct.)	34.8	32.4
Life Science Employment Change, '95-'01 (pct.)	11.0	7.3

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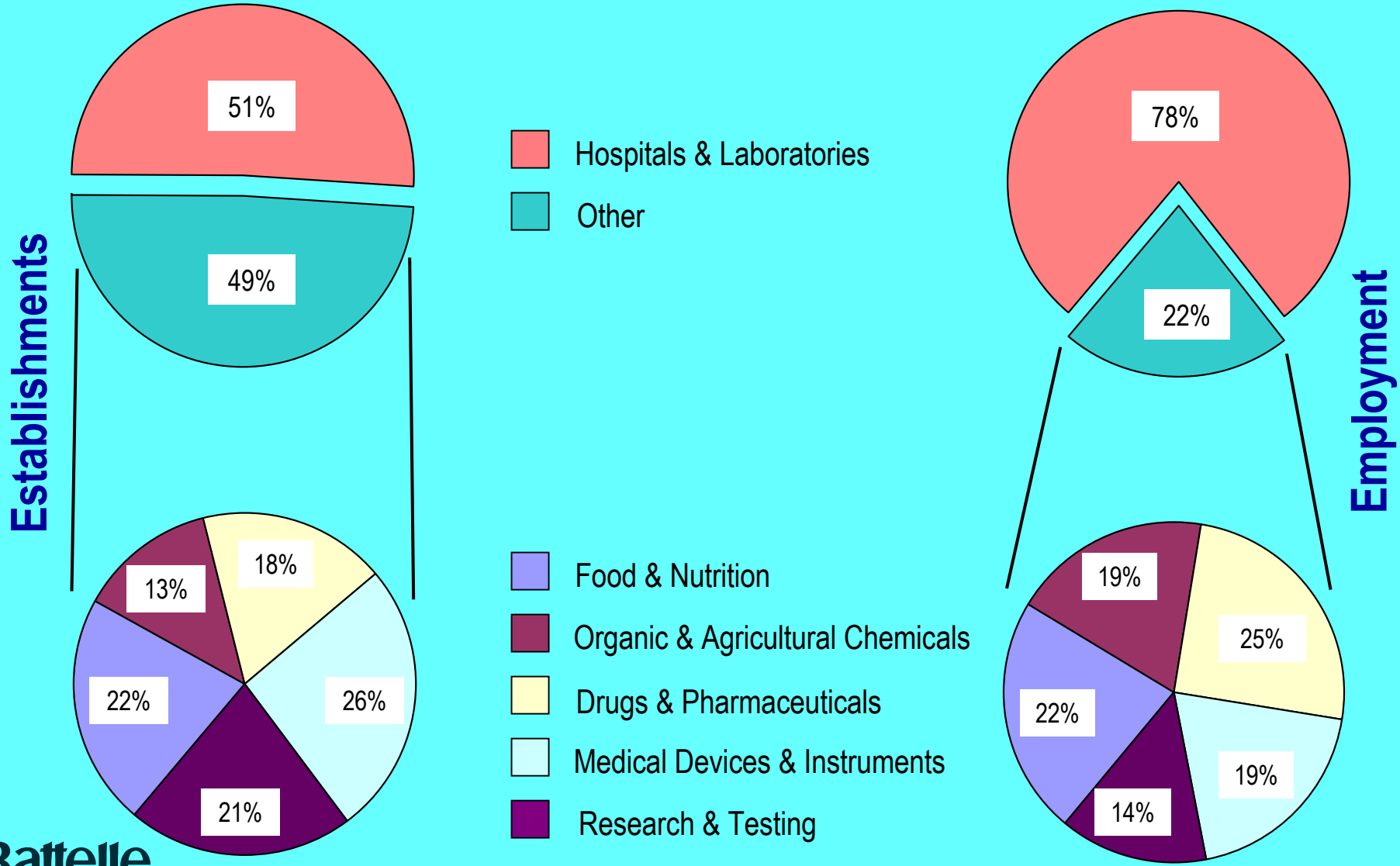
Dominance of Hospitals and Laboratories in Missouri



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Life Science Subsector Summaries—Specializations and Concentrations

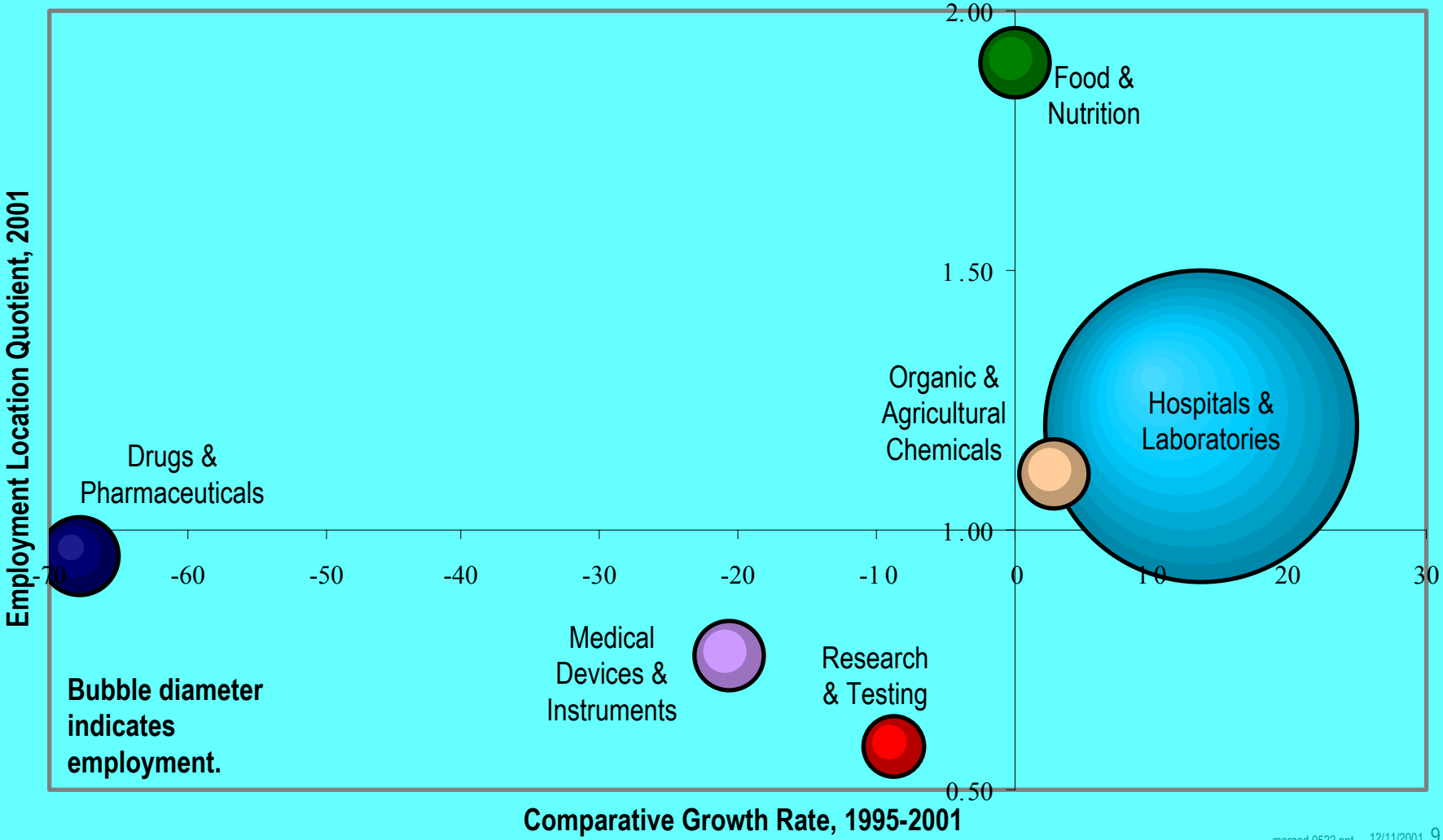
- Hospitals & Laboratories – LQ 1.20
  - largest subsector: 151,000+ employees, 926 estab.
  - 17.5% employment rise despite 3.8% nationwide growth rate
  - locally-supported growth, more than countering effects of national consolidation trend
- Food & Nutrition – LQ 1.90
  - Missouri's strongest specialization
  - 9,300 employees, 196 estab.
  - regional and national employment holding steady
- Organic & Agricultural Chemicals – LQ 1.11
  - 7,900 employees, 116 estab.
  - 1.3% employment increase just above national decline of 0.8%—both holding relatively steady

Life Science Subsector Summaries—Other Subsectors

- Drugs & Pharmaceuticals – LQ 0.95
  - location quotient down from 1.76
  - 28.7% employment decline contrasts with 39.0% national increase
  - still employs 10,400
  - 31.1% rise in establishments to 156
  - employment drop due to large employers—merger & consolidation, closing, downsizing, & out-migration
- Medical Devices & Instruments – LQ 0.76
  - small, not a regional specialization
  - 8,000+ employees, 232 estab.
  - 7.4% decline in Missouri (large employers); 13.1% U.S. increase
- Research & Testing – LQ 0.58
  - smallest Missouri subsector
  - 5,900+ employees, 189 estab.
  - establishment increase rapid but slower than U.S.
  - employment growth less than U.S.
  - lack of entrepreneurial success?

Missouri Life Science Subsectors

➡ The Missouri subsectors currently demonstrating strength are those that tend to be less technology-intensive (food & nutrition) or have less economic impact potential (hospitals & labs).

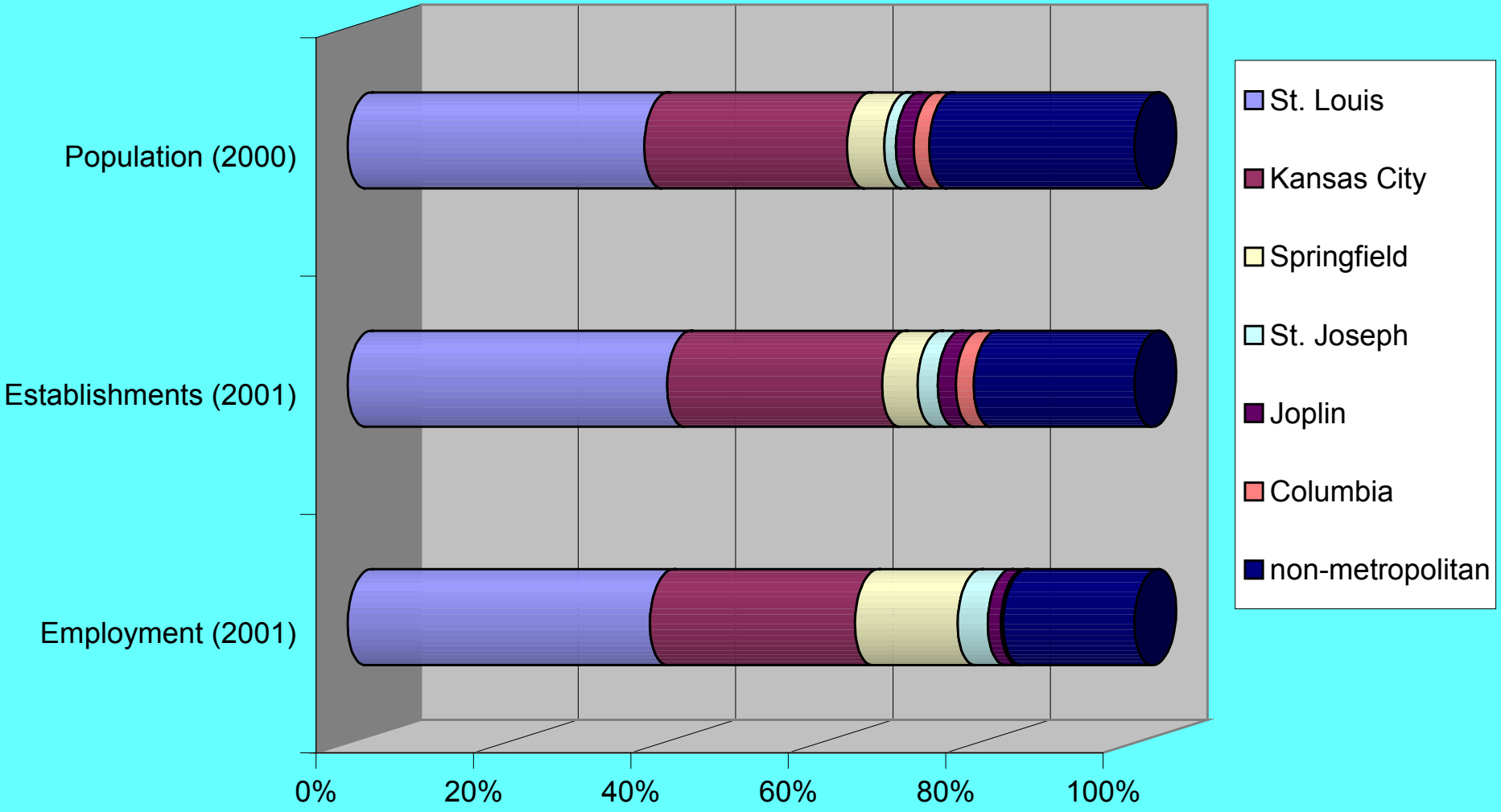


NOTE: The horizontal axis represents the difference between the growth rate in Missouri and across the United States.

Spatial Distribution of Missouri Life Sciences—Key Points

- More than **two thirds of bioscience establishments and employment are in metropolitan St. Louis and Kansas City**, comparable to population distribution
- **Statewide distribution of food & nutrition and hospitals & laboratories**
- Examples of smaller metro area concentrations include:
  - **Animal sciences pharmaceuticals (veterinary science) in St. Joseph**
  - **food & nutrition in Springfield and Joplin areas**
  - **research & testing in Columbia**
- Absence of clustering is due to large size and maturity of Missouri bioscience manufacturing—but may make service targeting, collaborations, and identity creation more difficult

Life Science Establishments and Employment—by Metropolitan Area



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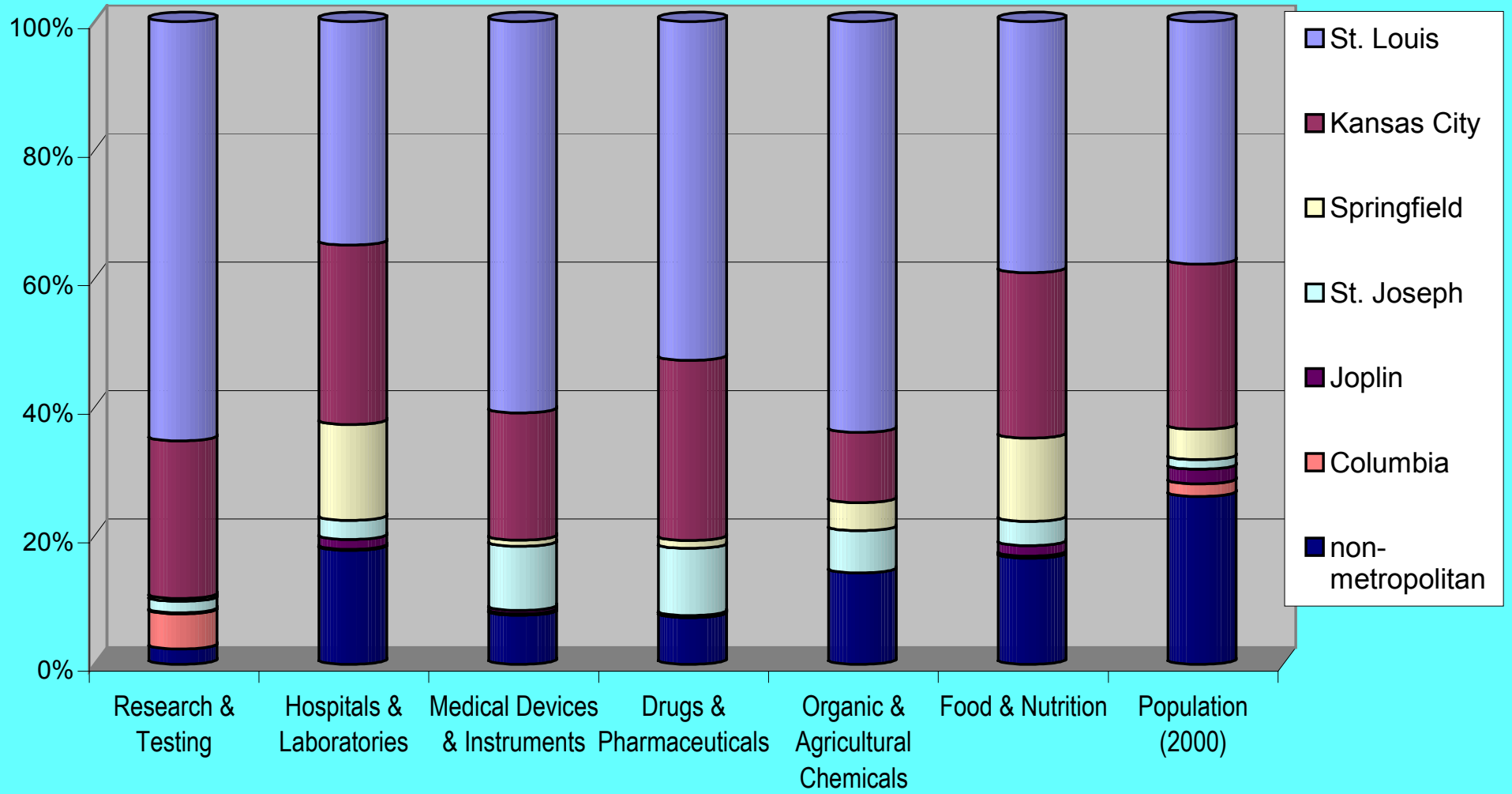
Life Science Subsector Employment by Metropolitan Area



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Age Characteristics of Life Science Establishments

- Less than 28% of Missouri **life science** establishments are five or fewer years old; accounting for 20% of bioscience employment (comparable to U.S. and benchmarks).
- Only 11% of Missouri **research & testing** employment is in young establishments, much less than U.S. and benchmark states (30% of establishments is better but low also) – indicates active entrepreneurialism but little recent success in employment generation.

Percent of Research & Testing Establishments and Employment Aged 0-5 years, 2001

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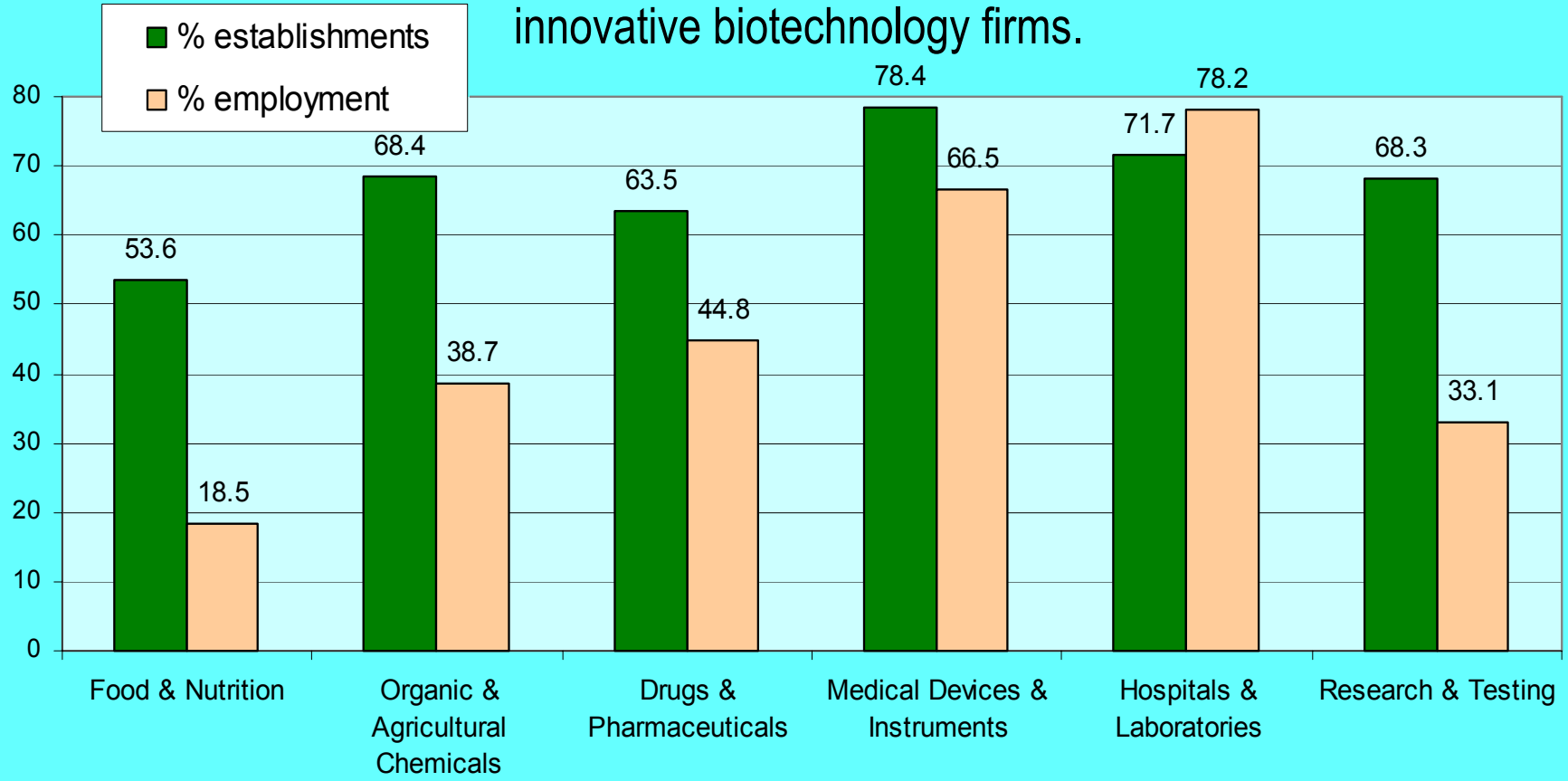
Local Control* of Life Science Establishments

➡ 70 percent of Missouri's **life science** establishments are headquarters or individual sites, exercising primary control over regional operations. These employ 70% of the life science workers in Missouri.

➡ Two thirds of research & testing employment is in branch sites, indicating a lack of local control and direction in this important sector containing many of the emerging and innovative biotechnology firms.



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* Local control = headquarters or individual sites

Missouri Life Sciences—At a Crossroads…

Performance of Missouri's life science subsectors has varied:

- Life science sector dominated by hospitals & laboratories, exhibiting locally-supported growth much stronger than national performance
- Rest of sector not performing nearly as well—decline in employment (3,440 jobs, 7.6%) since 1995
- Substantial specializations and employment in agricultural and ag-related subsectors
- Traditional biomedical manufacturing—with substantial employment and several major firms—could provide a solid foundation for growth, but currently is declining from mergers & downsizings (Mallinckrodt-Tyco, Hoechst-Marion Roussel Dow-Aventis, Monsanto-Pharmacia-Upjohn-Solutia)
- Missouri's continuing under-concentration in research & testing is important because the subsector contains many of the most innovative firms and the biotechnology fields attracting the most national attention (also less local control)

Preliminary Report: Benchmarking Competitor and Regional States

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Summary of Key Lessons Learned

- Ingredients for building a critical mass in the life sciences include:

  - Engaged universities with active leadership
  - Intensive networking across sectors and with industry
  - Available capital, including indigenous, covering all stages of the life cycle
  - Discretionary Federal or other R&D funding support, both exploratory and focused
  - Access to facilities and equipment
  - Workforce and talent pool on which to build and sustain efforts
  - Patience and a long-term perspective and commitment

Summary of benchmark profiling

State	Key factors
Illinois	■ State has supported R&D opportunity funding and finance since 1980s ■ New "VentureTECH" adds money for facilities and venture capital ■ Chicago has crafted its strategy to track state-designated clusters ■ Peoria has own life-science/ag strategy; U-C fairly passive
Maryland	■ State has supported R&D facilities and programs since the 1980s ■ Commercial strategy adds incubators and range of early-stage capital ■ State has retooled traditional incentives for applicability to bioscience ■ Regional strategies leverage infrastructure such as fed labs, VC, etc.
North Carolina	■ Research Triangle *is* the expression of state strategy, since the 1950s ■ State supports R&D and financing through NCBC and NCTDA ■ Recent focus on incubation, entrepreneurship and early-stage capital ■ Raleigh has own unusual research park; Winston-Salem/Charlotte next

Summary of benchmark profiling, continued

State	Key factors
Ohio	■ State has funded statewide biotech center (now being regionalized) ■ State has highly flexible opportunity fund, new tech transfer funds ■ Emphasis in venture financing moving to earlier stages ■ Cleveland, Columbus and Cincinnati have all drafted life-science plans
Oklahoma	■ State has modest support for R&D, heavy emphasis on capital formation ■ Recently has added seed-stage commercialization financing ■ Oklahoma City has become the designated life-science center ■Significant investments have been made in Research Parks
Pennsylvania	■State has funded regional centers since the 1980s ■ Tech 21 strategy overlays sectoral responsibility on geography ■ Tobacco settlement will fund $60 million in annual bioscience R&D ■ Also $160 million one-time in 3 “Life Science Greenhouses in Phila., Pittsburgh and State College (the ag center)

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Summary, continued

State	Key factors
Texas	■ Almost no strategy at state level, but intense new expenditure ■ $500 m. for bricks and mortar, increased R&D, early-stage funding ■ Houston aiming for biotech leadership as Austin did for electronics ■ San Antonio will be a secondary center, complementing Austin

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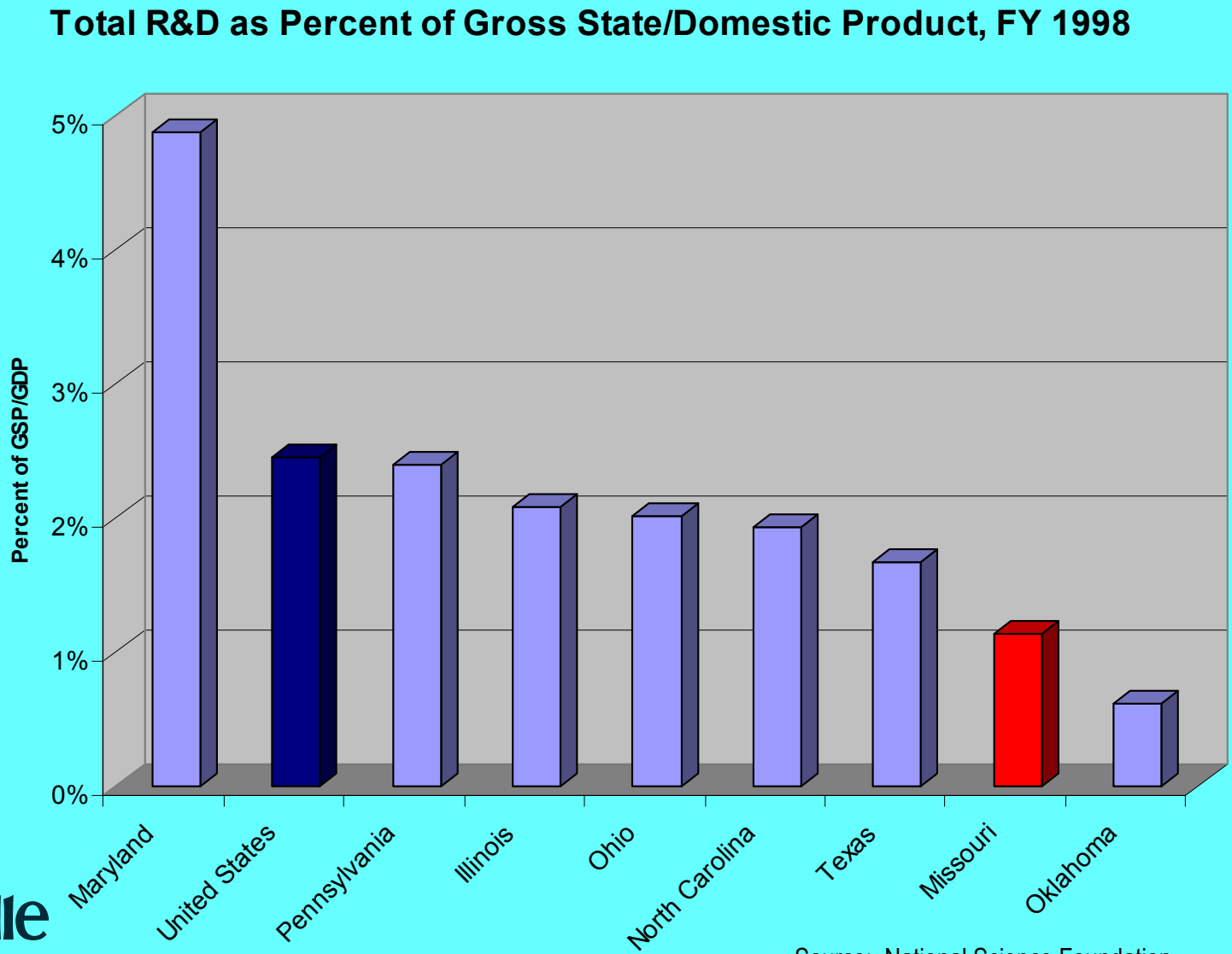
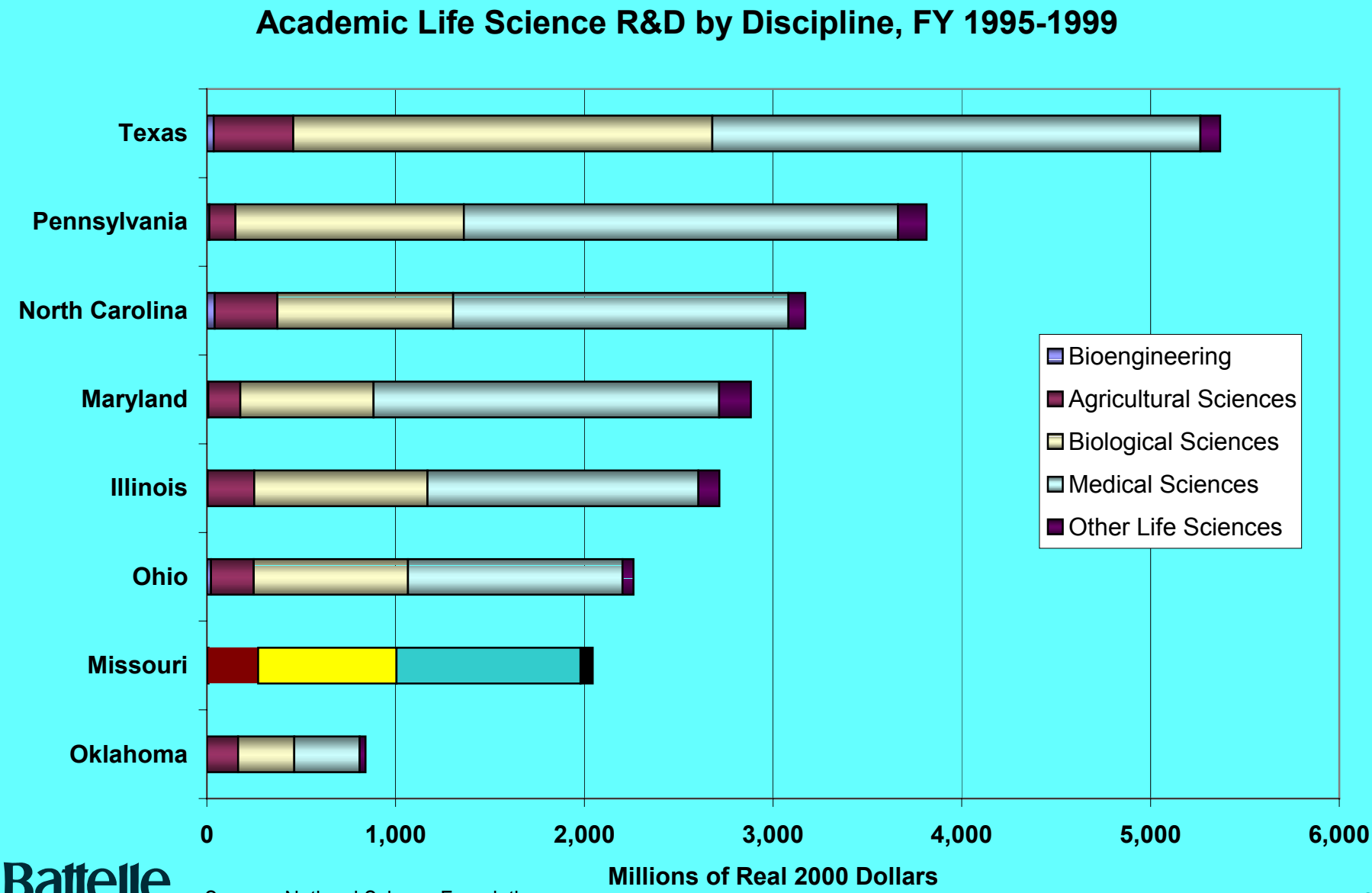
Missouri lags in total R&D (industrial, academic, govt.), adjusted for gross state product



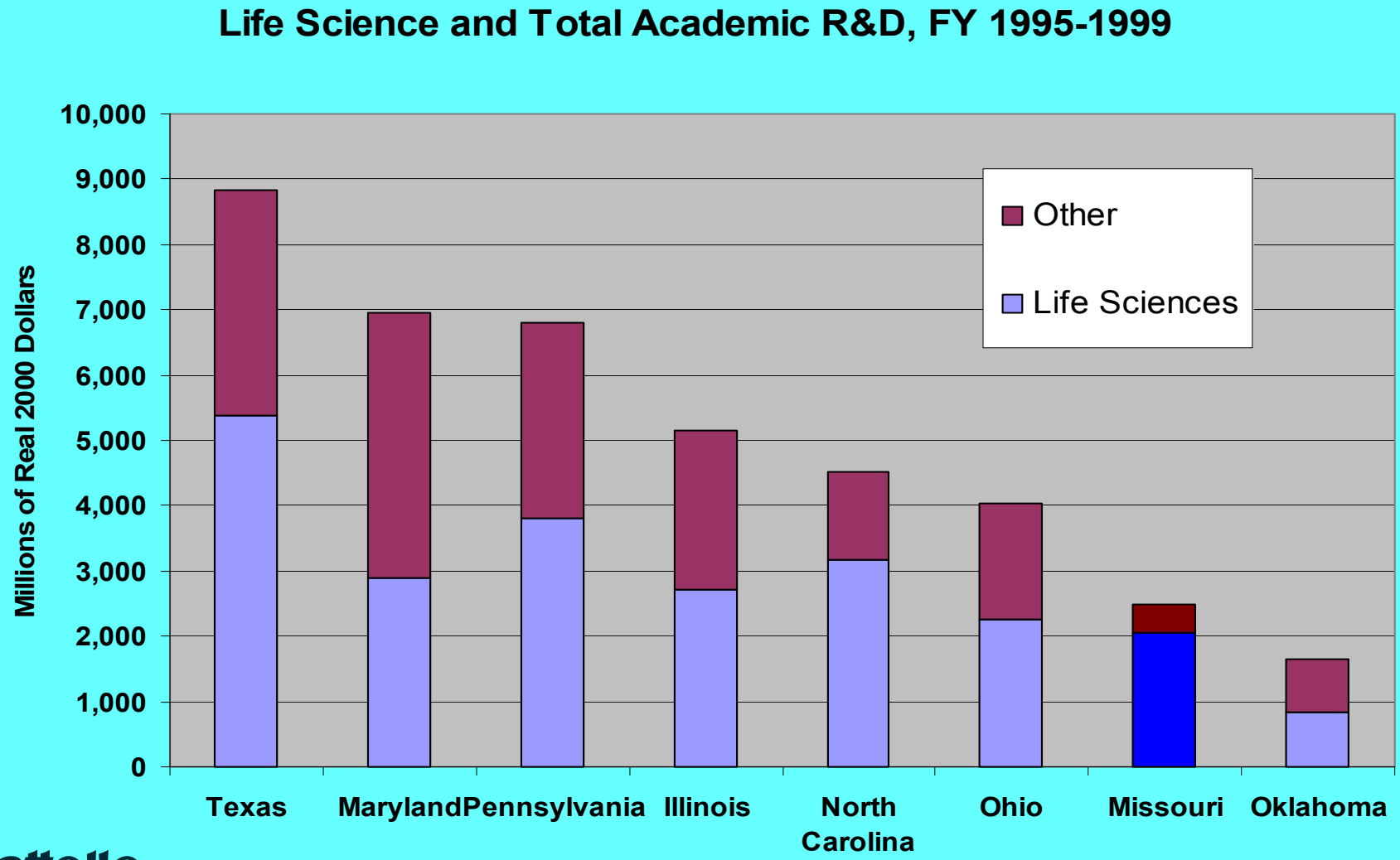
Source: National Science Foundation.

Missouri lags in academic R&D



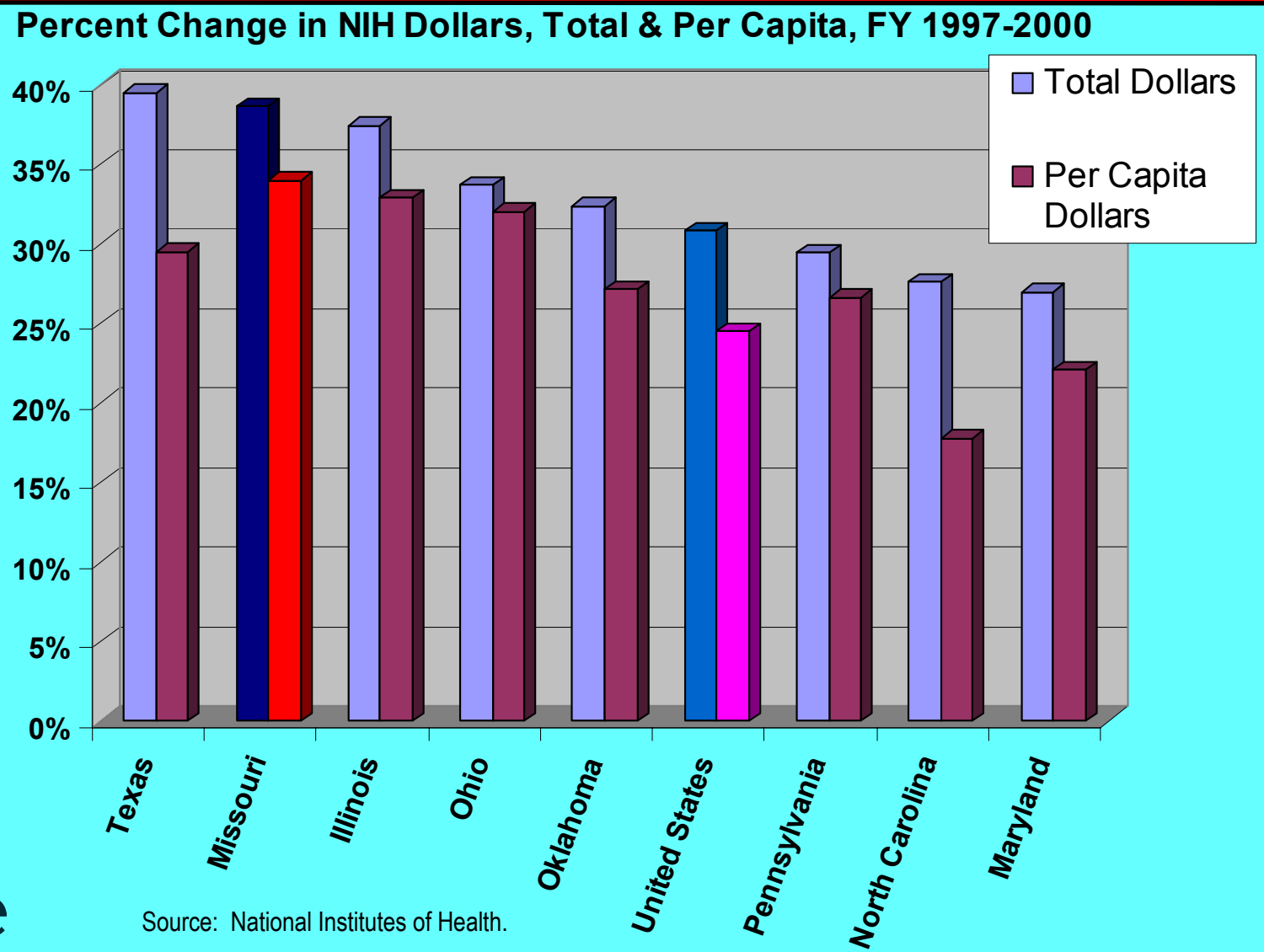
Source: National Science Foundation.

As a percentage of total academic R&D, Missouri is the most specialized in life sciences



Source: National Science Foundation.

Growth rate in NIH funding is second in this set to Texas, and highest on a per-capita basis



Source: National Institutes of Health.

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In funding from NIH, Missouri is competitive in per capita terms and in growth rate

	FY 2000				% Change FY 1997-2000	
	Grants	Amount	State Rank	Per Capita	Amount	Per Capita
Illinois	1,611	$473,148,806	9	$38	37.4%	32.9%
Maryland	2,063	$868,641,136	5	$164	27.0%	22.1%
Missouri	**1,069**	**$366,949,801**	**12**	**$66**	**38.6%**	**34.0%**
North Carolina	1,585	$581,097,379	7	$72	27.6%	17.8%
Ohio	1,538	$463,886,400	10	$41	33.7%	32.0%
Oklahoma	157	$44,429,048	37	$13	32.4%	27.1%
Pennsylvania	2,936	$946,261,320	4	$77	29.4%	26.6%
Texas	2,325	$765,113,382	6	$37	39.5%	29.5%
United States	*43,991*	*$14,571,522,427*	*n.a.*	*$52*	*30.8%*	*24.5%*

Note: Bioscience R&D Dollars are in thousands of real 2000 dollars

Source: National Institutes of Health; United States Census Bureau (population); Battelle Calculations

Note: The Illinois portion of the St. Louis metropolitan area is included in Illinois and the Kansas portion of the Kansas City metropolitan area is not included.

Note: Missouri would be ranked 28th without Washington University.

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One reason…Washington University's high national rank "carries" the state's results

Institution	Total Grants	Total Amount	Institutional Rank	Research Grants	Research Amount	Institutional Rank
Washington University	710	$279,478,547	5	628	$258,540,029	5
University of Kansas system	160	$43,628,711	84	141	$39,679,655	83
University of Missouri	166	$34,207,377	98	147	$31,456,552	96
St. Louis University	90	$21,574,038	129	81	$20,267,114	127
Barnes-Jewish Hospital	60	$16,670,003	144	58	$15,901,686	139
Midwest Research Institute	4	$6,077,290	260	0	$0	2,301
Southern Illinois University at Edwardsville	2	$122,433	1,876	2	$122,433	1,573

Note: Ranks are for US institutions only: 2,407 total institutions.

Note: The Illinois portion of the St. Louis metropolitan area is included in Illinois and the Kansas portion of the Kansas City metropolitan area is not included.

Note: The University of Kansas Medical Center is grouped with the overall University of Kansas system.

Source: National Institutes of Health.

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Missouri Not Concentrated in Patent Awards but Competitive in Bioscience Share of Total

	Bioscience Related Patents FY '00	Avg. Bioscience Patents '96-'00	Percent Change of Bioscience Patents Issued '96-'00	Bioscience Related Patents as a % of All Patents FY '96	Bioscience Related Patents as a % of All Patents FY '00	State Share of Total U.S. Bioscience Patents 1996	State Share of Total U.S. Bioscience Patents 2000
Illinois	656	568	28.1%	16.3%	17.1%	4.6%	3.9%
Maryland	499	494	51.7%	29.9%	36.8%	2.9%	3.0%
Missouri	**213**	**218**	**35.7%**	**23.9%**	**25.9%**	**1.4%**	**1.3%**
North Carolina	327	287	45.3%	18.9%	17.7%	2.0%	1.9%
Ohio	548	536	30.8%	16.0%	17.1%	3.8%	3.3%
Oklahoma	94	89	11.9%	17.5%	17.3%	0.8%	0.6%
Pennsylvania	834	762	38.8%	20.6%	22.9%	5.4%	5.0%
Texas	788	671	63.8%	11.5%	12.5%	4.3%	4.7%
United States	*16,777*	*15,102*	*50.3%*	*18.3%*	*19.7%*	*100.0%*	*100.0%*

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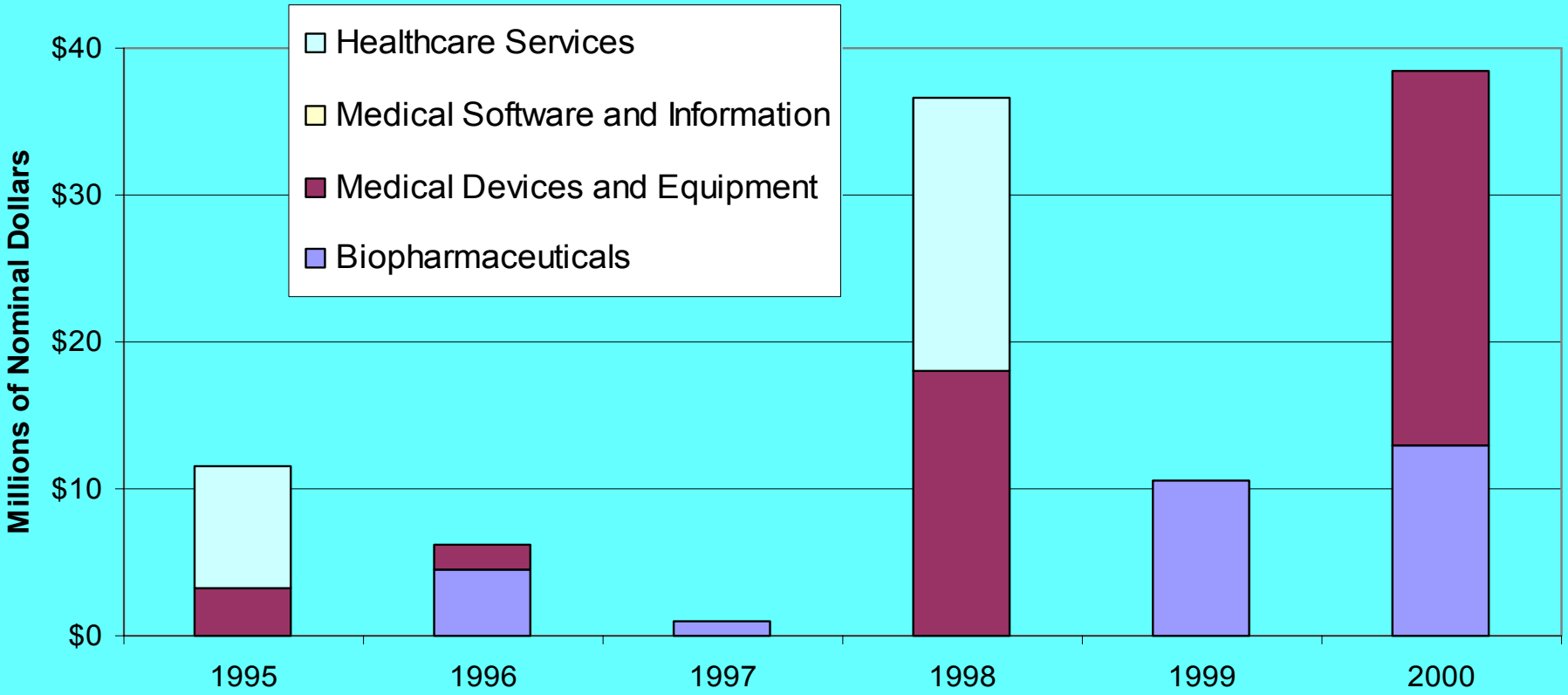
Venture Capital for Life Sciences in Missouri

- In Q1-Q3 2001, Missouri garnered $9.85 M, mainly in medical software and information, compared to $25.5 M in medical devices and equipment during the same period of 2000.



Source: PricewaterhouseCoopers *MoneyTree* survey.

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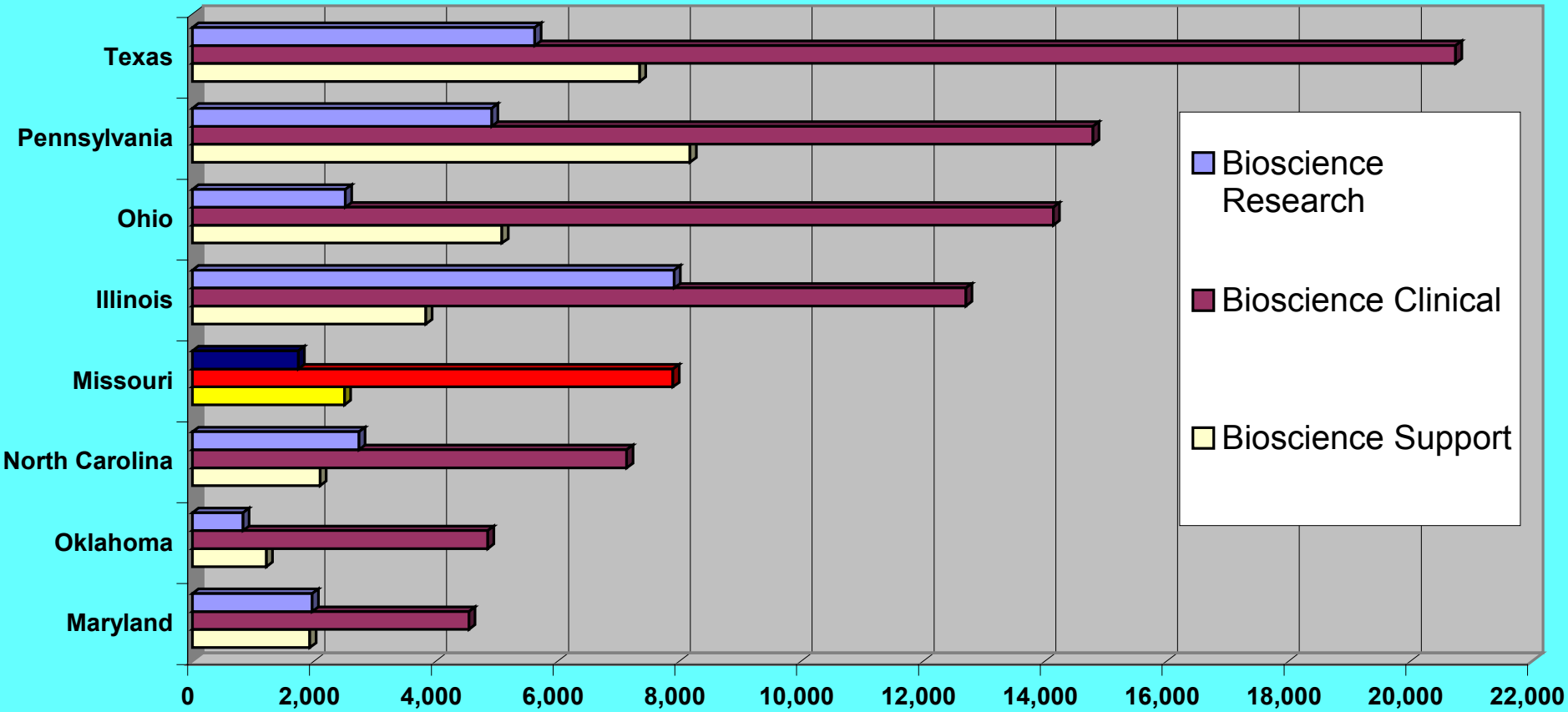
Workforce in benchmark states

Missouri produces fewer life science research graduates per existing life science job than any of the benchmark states. In raw number, only Oklahoma has fewer degrees in these fields.

Life Science Degrees Awarded, All Levels, 1999-2000 Academic Year



Source: National Center for Education Statistics.

Missouri Life Sciences—At The Crossroads…

- Missouri currently is neither a clear leader nor a straggler—coming years will determine path for the future
- Employment and establishment base quite diversified with strengths across many areas of animal, plant, and human life sciences—but decline in non-clinical areas and relatively slow growth in biotechnology research & testing need to be addressed
- Research base growing with new research organizations (Stowers, Danforth Plant Sciences Center) and strength at Washington University; not as strong elsewhere
- Technology commercialization and entrepreneurship may need to get more attention built around strong industry anchors such as Monsanto, Bayer, Phoenix and other manufacturing firms

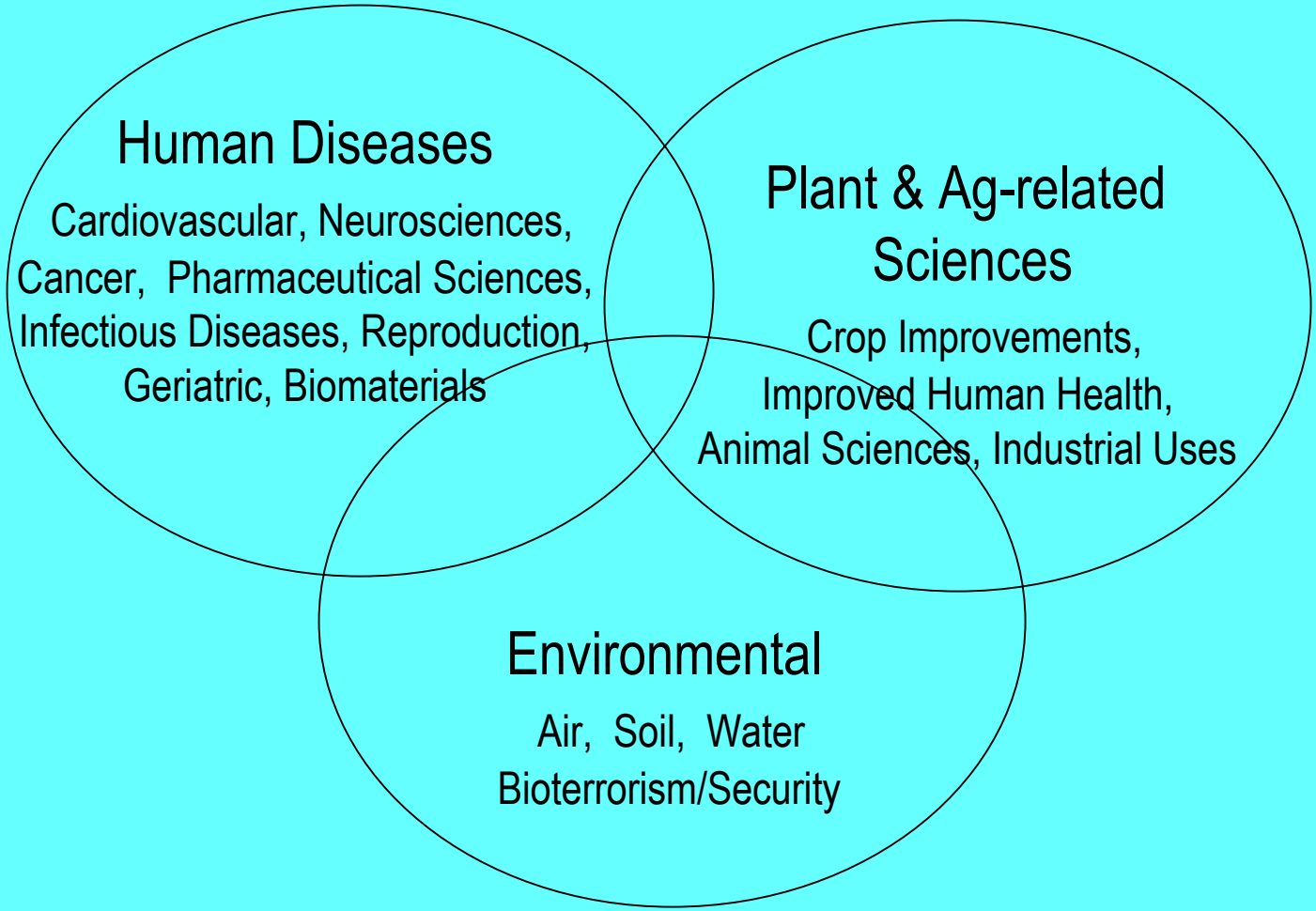
Core Competencies: Key Characteristics

- Substantial and fast growing life Sciences research base –
- Major new emphasis on life science research with advent of world-class new non-profit research organizations (Stowers/Danforth) and growing research focus at existing universities.
- Broad based strengths –
  - Statewide focus – not limited to individual region, found across state
  - Strong links with basic research
  - Multiple applications

Three Key Areas of Life Science Research Strengths

- Human Disease Treatment
- Plant and Ag-Related Sciences
- Environmental Technologies

Depiction of Missouri University Research Core Focus Areas



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A Vision for Missouri in the Life Sciences

Missouri will be a leading Midwest life sciences center, among the nation's and world's leaders, in plant, animal, and human health, recognized for its world-class research and exceptional ability to commercialize research discoveries into new products and services.

Missouri will be home to leading edge researchers and leading edge firms whose discoveries and products contribute to both a healthy citizenry and a healthy economy, driven by the strong base that has emerged in the State's life sciences base.

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Missouri's Life Sciences Mission

Missouri will invest from many sources (state, federal, philanthropic, industry) to enhance its research base through private/public partnerships to insure world class leadership in core research fields. Missouri will also encourage collaboration among and between its research institutions, industry, and established value-added intermediary organizations. Technology commercialization efforts will be enhanced and expanded so as to increase the rate of commercial application from research, resulting in firms, jobs, and wealth for the state and its citizens.

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Missouri Life Sciences - At The Crossroads… Situational Analysis

- Missouri currently is neither a clear leader nor a straggler— the coming years will determine its path for the future.
- The State's employment and establishment base are quite diversified with strengths across many areas of animal, plant, environmental and human life sciences—but decline in non-clinical areas and relatively slow growth in biotechnology research & testing need to be addressed.
- The research base is growing with new research organizations (Stowers, Danforth Plant Sciences Center) and existing strength at Washington University; unfortunately, not as strong elsewhere.
- Technology commercialization and entrepreneurship needs more attention to capitalize on strong industry anchors such as Monsanto, Bayer, Phoenix and other manufacturing firms.

Situational Analysis, cont.

- Missouri must build on differentiated needs and its respective regional strengths and niches which include animal, plant, and human health
  - Kansas City must build the research base first, and develop the technology commercialization capacity over time, while continuing to support the existing life science industry anchors.
  - St. Louis must while aggressively build industry connections and commercialization, while further enhancing its research base
  - Rolla-Ft. Leonard Wood must strengthen the connections and depth of its niches in environmental sciences and bioterrorism.
  - Other regions must address workforce needs and applications development through better linkages to this metro infrastructure.
- Collaboration within and across the state's regions among research entities and firms need to be strengthened to build on the state's existing base in research and firms

Situational Analysis, cont.

- Knowledge and awareness by all citizens, urban and rural, is absolutely critical to securing and maintaining long term state support.
- The life science base will grow from its research base through startups, business expansions and recruitment
  - The strong existing bioprocess manufacturing base must become more value added and growth oriented
  - Research & testing/drugs and pharmaceuticals must be given more focus and attention
- Missouri must not be the “show me” state but “show you” state transitioning and building on its base for a productive future
- Building research capability must be done simultaneously with creating the mechanisms, vehicles, and approaches for business mentoring and modernization.
- Life sciences involves all sectors (public, private, higher education) and many industries including information technologies and advanced manufacturing.

Proposed Missouri Life Sciences Strategies

- **Strategy One:** Enhance the State's higher education research and development infrastructure for world-class research in areas of core competency while increasing industry collaboration.
- **Strategy Two:** Create a critical mass of life science companies by focusing on commercialization, access to capital for new firm creation, expansion, and recruitment.
- **Strategy Three:** Create a supportive business, tax, and regulatory climate for life science companies, and a national and international image as a leading center in the life sciences.
- **Strategy Four:** Address the need to increase the pipeline of students and future workers interested in pursuing careers and opportunities in the life sciences.

Examples of Possible Actions

- Permanent funding for life sciences research from tobacco settlement
- Increased state investments in life sciences investments in higher education
- R & D matching grant program
- Incentive funding for consortia with industry and multi-disciplinary curricula
- Technology Development/Commercialization Fund
- Expanded tech commercialization function
- Expanded internship/co-op programs
- Tech financing for startups, expansions, research parks

Building Urban/Rural Linkages in Missouri

- Life sciences can benefit the entire state
- Talent comes from small metro and rural as well as urban
- Regional universities can help address talent and application/problem-solving with niche industries such as bioprocessing and related manufacturing
- Metropolitan universities and institutes can position the state as world class R & D centers
- Linkages and connectivity between large and small metro and non-metro areas are key – incentives, delivery systems, education, outreach and advocacy

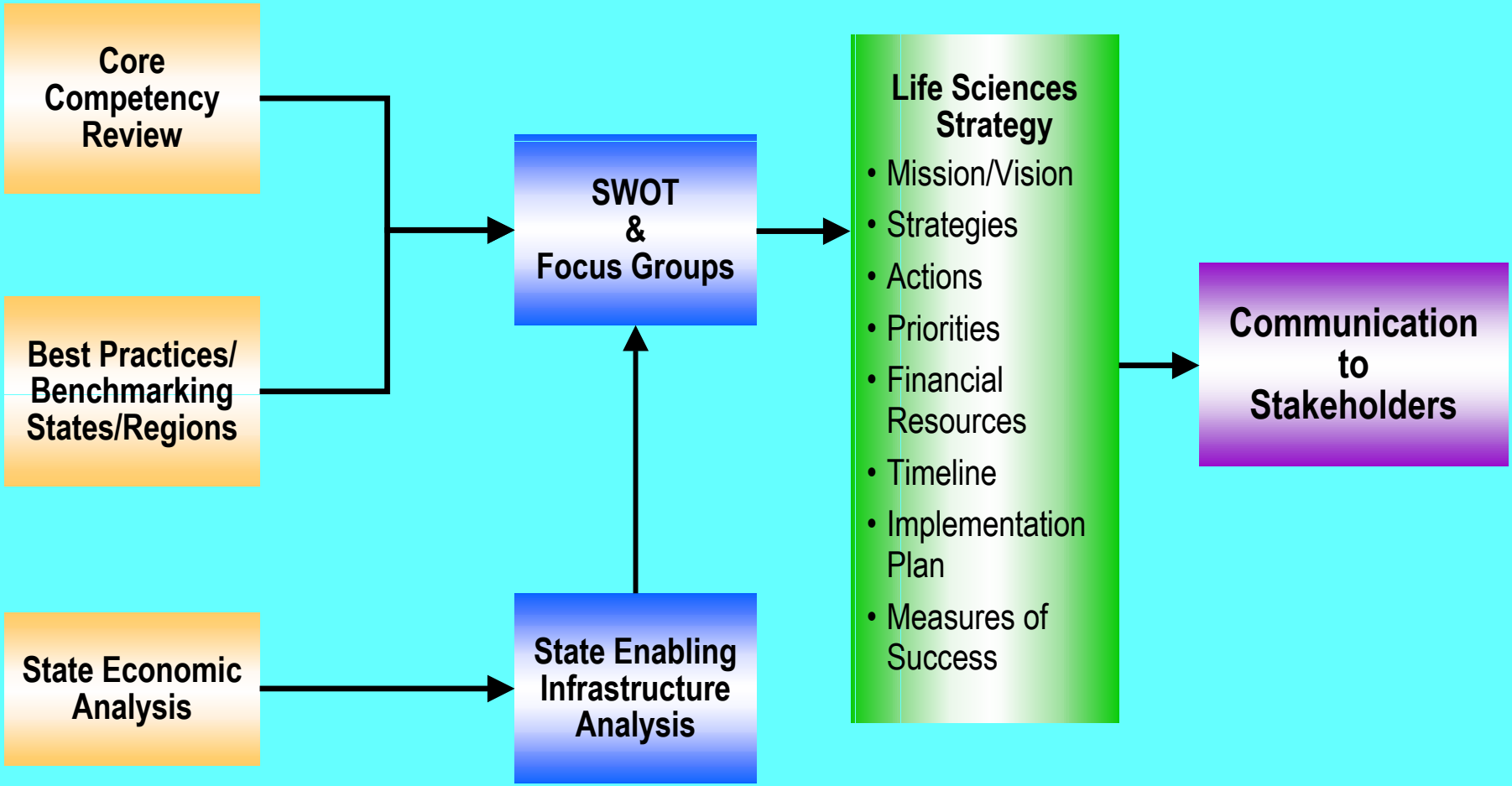
Key Success Factors

- Key **stakeholders** and **champions**
- **Citizenry** and key leadership **understanding**
- **Long-term commitment**

Conclusion

- Missouri has the potential to become a leading Midwest and national life sciences center. To do so, however, will require:
  - Investing significantly in the public research university base by focusing on core competencies
  - Investing in the "technology infrastructure" that helps organize and connect industry and academia to build a critical mass of life sciences firms
  - Address key issues in the business climate critical to growth of this industry including tax policies, availability of capital, and talent base for the future
  - Building Missouri's image as a center for the biosciences

Methodology for Missouri Life Sciences Strategy Development



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